ACR Grazing Land and Livestock Management (GLLM) Methodology

SB 1383 Subgroup #1: Fostering Markets for Non-Digester Projects
Sacramento, CA
May 21, 2018

Objectives

- Comprehensive and flexible accounting framework for broad range of beef and dairy GHG mitigation activities
- Focuses on five primary GHG sources/sinks: enteric, manure, fertilizer, fossil fuel, and biotic sequestration
  - Provides modular accounting methods for each of these
  - Tiered approach based on size of impacts
  - Not all necessarily required; depends on project activity
- Non-prescriptive

  - Producer decides what practice change to undertake
  - Methodology doesn't prescribe what to do, only how to do the accounting, using applicable modules

Applicability Conditions

- Dairy and beef operations only
- Project lands managed for grazing/livestock in the project scenario

- Example practices:
  - Implement rotational and management intensive grazing in beef and dairy
  - Dietary changes
  - Feed additives
  - Change manure management system
  - Tree planting (silvopasture)
  - Convert cropland to pasture

Framework Module

- Overall structure and functionality of methodology
- Applicability conditions for the methodology overall
- Defining the project boundary (geographic boundary, temporal boundary, and GHG SSRs included/excluded from accounting)
- Demonstrating additionality
- Formula to calculate ERTs using output parameters of other modules
- Monitoring requirements

Project Boundary

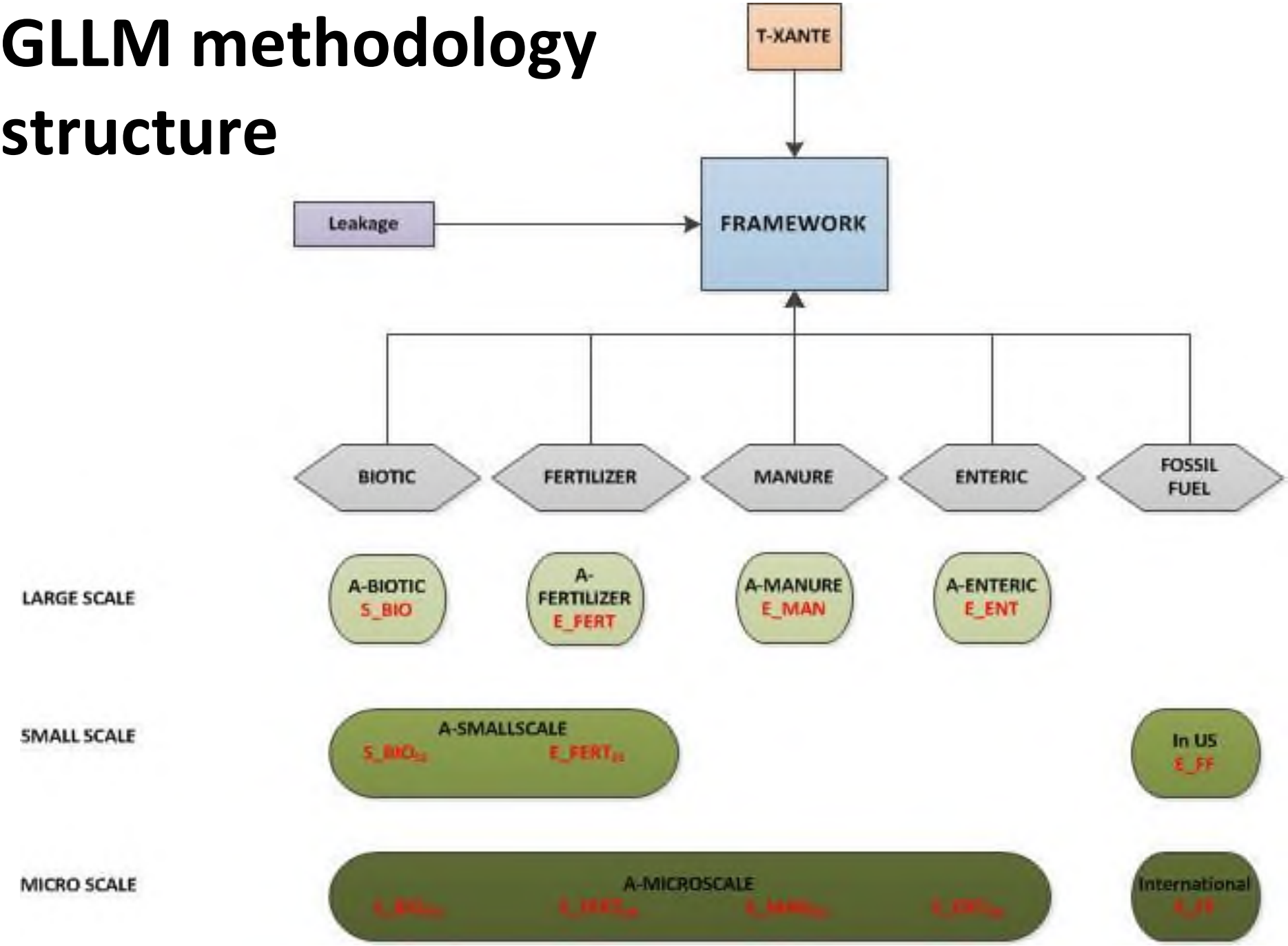
- Facilities and lands where livestock are held, fed and grazed, in both baseline and project scenarios
  - All entities over which Project Proponent has effective control; may span several commercial entities
  - May include analytical units corresponding to animal management rather than land areas
- May not exclude lands/facilities where emissions increase due to project activity
- May include multiple areas, facilities, owners, and start dates (aggregated)

Accounting Modules

Complexity and data requirements of required accounting method correspond to the scale of impacts expected in a particular SSR

T-XANTE	Ex ante estimate of net reductions directs user to A-MICROSCALE, A-SMALLSCALE, or full accounting module
A-MICROSCALE	Excel tool – simple emission factors, low data requirements when estimated impacts on a SSR are <5,000 tCO_2e/y
A-SMALLSCALE	Used in U.S. for biotic, fertilizer and fossil fuel impacts between 5,000 and 60,000 tCO_2e/y. (uses IPCC Tier 2 methods)
A-ENTERIC	Used for impacts >5,000 tCO_2e/y
A-MANURE	Used for impacts >5,000 tCO_2e/y
A-FERTILIZER	Used in U.S. for impacts >60,000 tCO_2e/y and outside US for impacts >5,000 tCO_2e/y
A-BIOTIC	Used in U.S. for impacts >60,000 tCO_2e/y and outside US for impacts >5,000 tCO_2e/y
L-GLLM	Activity-shifting and market effects leakage emissions
T-RISK	Tool for calculating buffer contribution for biotic sequestration

GLLM methodology structure



Scaled Approach to GHG Accounting

The magnitude of estimated GHG impacts determines the accounting approach

Need an accounting approach before you know the magnitude of estimated GHG impacts

start here

MICRO SCALE

[redacted]

< 5,000 t CO_2e/y

< 5,000 t CO_2e/y

SMALL SCALE

[redacted]

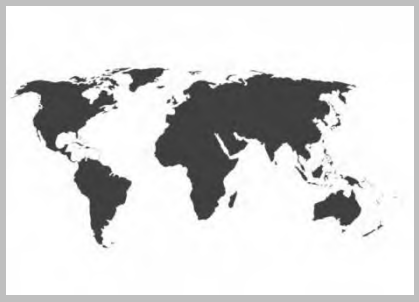
5,000 to 60,000 t CO_2e/y

AND
Direct FF Emissions < 60,000 t CO_2e/y

LARGE SCALE

[redacted]

> 60,000 t CO_2e/y



> 5,000 t CO_2e/y

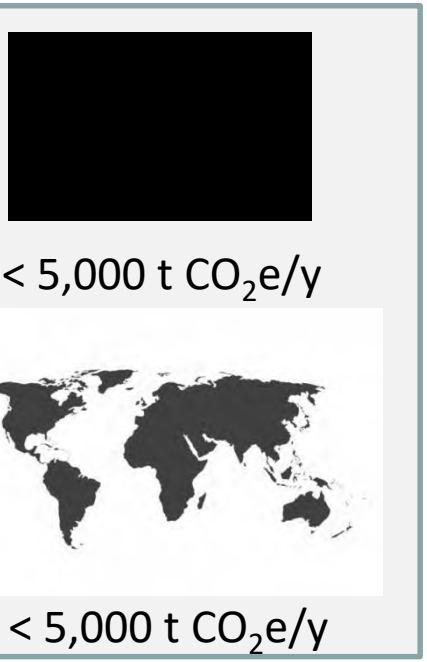
Net ER Calculation

$$ERT\_GLLM_t = E\_ENT + E\_MAN + E\_FERT + E\_FF + (S\_BIO * (1 - Buffer\%)) - E\_LK$$

- E_ENT, E_MAN etc. from applicable module (large, small or micro scale)
- $Buffer\%$ from T-RISK tool and is only a deduction from activities with biotic sequestration
- E_LK from L-GLLM and includes both activity-shifting leakage (if required) and market leakage

MICROSCALE Module

MICRO SCALE



- Excel spreadsheet-based tool
- Simplified, automated GHG accounting procedures applied
- Provides a preliminary estimate of expected emission reductions from each source category:
  - Biotic Sequestration (S-BIO)
  - Enteric Fermentation (E-ENT)
  - Manure Management (E-MAN)
  - Fertilizer Use (E-FERT)
  - Fossil Fuel Use (E-FF)
- Output is based on data inputs provided by user for baseline and project scenarios
- Results of A-MICROSCALE → T-XANTE

Microscale: Biotic Sequestration

- Based on IPCC Tier 1 accounting methodology

A-MICROSCALE

Parameter Name:	S_BIO
Parameter Description:	Net microscale biotic sequestration/emissions (t CO_2e)
Calculated value:	33,229 t CO_2e yr^{-1}

Instructions: Enter data into the light blue cells for both baseline and project scenarios. Use the unit converter box in the upper right as needed.

Select from drop-down menus.

Geographic Region:	North America
Climate Region:	Warm Temperate Moist
Soil Type:	Low Activity Clay

Size of Project Area:	5,000 ha

	BASELINE DATA	PROJECT DATA
Land Cover Type	Long Term Cultivated Crop	Grassland
Grassland Management	N/A	Improved
Grassland Inputs	Medium	High
Cropland Management	Full Tillage	N/A
Cropland Inputs	Medium	N/A

Are you planting trees in the project area? No

Land Cover Type
LT Cultivated Crop: Continuously managed >20 yrs with annual crops.
ST Set Aside: Temporary set aside of annual crop or other idle cropland.
Grassland: Ranges from extensively managed rangelands to intensively managed continuous pasture and hay land.

Microscale: Enteric Fermentation

American Carbon Registry

Parameter Name:	E_ENT
Parameter Description:	Net microscale enteric emissions (t CO_2e)
Calculated value:	0 t CO_2e yr^{-1}

INSTRUCTIONS: Enter data into LIGHT BLUE CELLS for both baseline and project scenarios. Change values in gray cells only if you have project specific data, otherwise leave existing default values as they appear in the cell.

Geographic Region: North America

BASELINE DATA

Click on category to see description. -->	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement /growing	Feedlot cattle
Number of Animals Produced Per Year	1,000			75	300	150	300
% of Females that give birth in a year:	90			0	0	0	0
Feeding Situation: Enter the % of the year under each feeding situation per animal category.							
Stall-fed/Confined (tethered, pen, barn)	80			80	80	80	80
On pasture (confined in areas with sufficient forage)	20			20	20	20	20
Grazing large areas (i.e., rangeland)	0	0	0	0	0	0	0
Average Live-Weight of Animal (kg)	600	500	800	185	265	375	415
Average Daily Weight Gain (kg day^{-1})	0.0	0.0	0.0	0.9	0.7	0.4	1.3
Total Annual Milk Production (kg cow-1 yr^{-1})	8,395	1,205	0	0	0	0	0
Fat content of milk: (%)	4.0	4.0	0	0	0	0	0

Cows used to produce offspring for meat OR cows used for more than one production purposes: milk/meat

PROJECT DATA

	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement/growing	Feedlot cattle
Number of Animals Produced Per Year	1,000	900	40	75	300	150	300
% of Females that give birth in a year:	90	80	0	0	0	0	0
Stall-fed/Confined (tethered, pen, barn)	80	80	80	80	80	80	80
On pasture (confined in areas with sufficient forage)	20	20	20	20	20	20	20
Grazing large areas (i.e., rangeland)	0	0	0	0	0	0	0
Average Live-Weight of Animal (kg)	600	500	800	185	265	375	415
Average Daily Weight Gain (kg day^{-1})	0.0	0.0	0.0	0.9	0.7	0.4	1.3
Total Annual Milk Production (kg cow-1 yr^{-1})	8,395	1,205	0	0	0	0	0
Fat content of milk: (%)	4.0	4.0	0	0	0	0	0

Feeding Regime: Enter the type and % of each feed in the total annual diet of each animal category.

Select feed name from drop down menu.

% of total diet (Baseline)

Feed Name	Int'l Feed #	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement /growing	Feedlot cattle
Corn, distiller's grains w/ solubles, dried	5-28-236	50	50	100	0	100	100	100
Grasses, intensively managed pasture	1-02-244	50	50	0	100	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0

(Project)

Feed Name	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement/growing	Feedlot cattle
Corn, distiller's grains w/ solubles, dried	50	50	100	0	100	100	100
Grasses, intensively managed pasture	50	50	0	100	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0

Microscale: Manure Management

A-MICROSCALE

Parameter Name:	E_MAN
Parameter Description:	Net microscale manure emissions (t CO_2e)
Calculated value :	402 t CO_2e yr^{-1}

Instructions: Enter data into light blue cells for both baseline and project scenarios.

Geographic Region:	North America
Average Annual Temperature:	18 ° C

	% of manure managed under each system	
Manure Management System	**Baseline**	**Project**
Pasture/Range/Paddock	0	0
Daily Spread	0	0
Solid Storage	100	0
Dry Lot	0	0
Liquid/Slurry with crust	0	0
Liquid/Slurry without crust	0	0
Uncovered anaerobic lagoon	0	0
Pit storage <1 month	0	100
Pit storage >1 month	0	0
Anaerobic digester	0	0
Burned for fuel	0	0
Deep bedding <1 month, no mixing	0	0
Deep bedding <1 month, active mixing	0	0
Deep bedding >1 month, no mixing	0	0
Deep bedding >1 month, active mixing	0	0
Composting - In-Vessel	0	0
Composting - static pile	0	0
Composting - intensive windrow	0	0
Composting - passive windrow	0	0
Aerobic treatment	0	0

Based on IPCC Tier 2 methodology → different manure management systems specified

Microscale: Fertilizer Use

A - MICROSCALE

UNIT CONVERTER

	pounds =		kilograms (kg)
	acres =		hectares (ha)

Parameter Name:	E-FERT
Parameter Description:	Net microscale fertilizer emissions (t CO_2e)
Calculated value:	**-193** t CO_2e yr^{-1}

Instructions: Enter data into light blue cells for both baseline and project scenarios.

	Baseline			Project		
Synthetic Fertilizer Application:	**Total Weight Applied (kg yr^{-1})**	**%N**	**Area of Land Where Fertilizer is Applied (ha)**	**Total Weight Applied (kg yr^{-1})**	**%N**	**Area of Land Where Fertilizer is Applied (ha)**
Anhydrous Ammonia (NH_3) "Ammonia"	15,000	82	5,000	15,000	82	5,000
Ammonium Sulfate [$(NH_4)2SO_4$]		21	5,000		21	5,000
Monoammonium Phosphate (MAP)		11	5,000		11	5,000
Diammonium Phosphate (DAP)		18	5,000		18	5,000
Ammonium Nitrate (NH_4NO_3)		34	5,000		34	5,000
Calcium Ammonium Nitrate (CAN)		26	5,000		26	5,000
Urea Application:						
Amount of urea fertilization (kg yr-1)	0		5,000	0		5,000
Organic Manure Application:						
% of managed manure applied to fields:	100			100		

Microscale: Fossil Fuel Use

A-MICROSCALE

Parameter Name:	E_FF
Parameter Description:	Net microscale fossil fuel emissions (t CO_2e)
Calculated value:	**153** t CO_2e yr^{-1}

Instructions: Enter data on annual fuel quantities into the light blue cells.

	Baseline	Project	Fuel Units
Ethane	0	0	Gallons
Propane	0	0	Gallons
Butane	0	0	Gallons
LPG	0	0	Gallons
Motor Gasoline	20,000	5,000	Gallons
Aviation Gasoline (avgas)	0	0	Gallons
Other Kerosene	0	0	Gallons
Gas/Diesel Oil	10,000	8,000	Gallons
Biodiesel	0	0	Gallons
Biogas	0	0	Gallons
Other Liquid Biofuels	0	0	Gallons

If necessary, change units using drop-down menus.

American Carbon Registry

T-XANTE

- Fully automated
- Uses results from A-MICROSCALE to display which modules should be used

Is your project located within the continental United States? **yes**

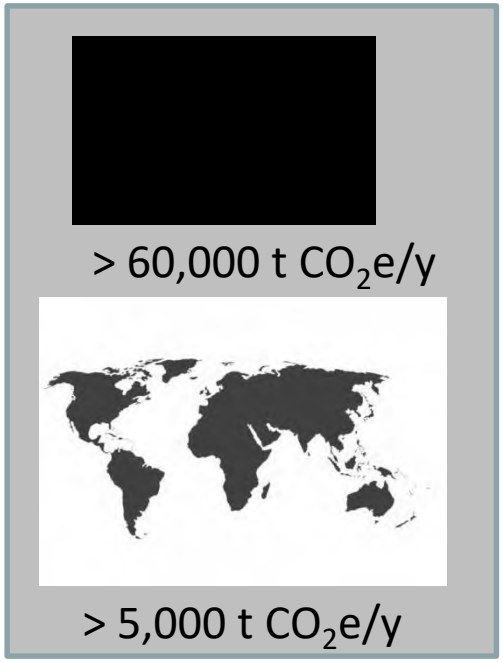
MODULE SELECTION FOR YOUR PROJECT:

	Emission Category	Module Selection
	Biotic Sequestration:	*A-SMALLSCALE*
<5,000 t CO_2e	*Enteric Fermentation:*	*A-MICROSCALE*
	Manure:	*A-MANURE*
<5,000 t CO_2e	*Fertilizer:*	*A-MICROSCALE*
<5,000 t CO_2e	*Fossil Fuel:*	*A-MICROSCALE*

The Large Scale Modules

LARGE SCALE

A-BIOTIC
A-ENTERIC
A-MANURE
A-FERTILIZER



May be elected instead for any or all of the applicable modules

A-BIOTIC: Model

- Examples include Century, DayCent and Roth-C
- Must be studies (e.g. journal articles demonstrating use of model is appropriate in region where it is being applied)
- Model must have potential to determine soil carbon to an identified depth while considering:
  - Crop/grass type and productivity
  - Crop/grass management (including tillage)
  - Livestock presence, type and number
  - Manure applied, produced and management of manure application/production
- Modeling of herbaceous vegetation is an optional capability that must be used where present
- Validation of model required with limited field data sampling at each verification

A-BIOTIC – Woody Biomass

ACR Tool for Estimation of Stocks in Carbon Pools and Emissions from Emissions Sources (CPES)

- Used to quantify sequestration from trees and shrubs
- Stocks derived from field measurement
- Baseline stocks equal to stocks at start of project

A-BIOTIC: Data Inputs

- Tillage
  - type
  - depth
  - frequency
- Livestock
  - presence
  - type
  - manure application, production and management
- Grass
  - type
  - productivity
  - management
- CPES
  - trees and shrubs (field measurement)

A-ENTERIC

- Divided by livestock sub-category:
  - Lactating cows
  - Dry cows
  - Heifers and steers
- Calculations based on empirical equations developed using animal and feed data collected in open-circuit respiration chambers from 1963 to 1995

A-ENTERIC Data Inputs

- Number of livestock
- Body weight of livestock
- Information about different feed types:
  - Composition of annual diet (% of each feed)
  - Dietary ether extract
  - Gross energy intake
  - Dietary neutral detergent fiber

A-MANURE

- Calculations based on Dairy GEM
- Dynamic baseline
- Emissions dependent on manure system and time of year (ambient temperature)
  - CO_2: methane flaring from enclosed manure storage
  - CH_4: sum of emissions from:
    - Barn floors and open lots
    - Stored manure (covered, uncovered, dry stacks)
    - Manure applied to fields
    - Manure from grazing animals
  - N_2O: sum of emissions from:
    - Barn floors / dry lots
    - Unenclosed storage of manure / stacked dry manure

A-MANURE Data Inputs

- Type(s) of manure management system(s)
- Quantity of feces produced
- Properties of feces:
  - Volatile solids content
  - Manure pH
- Quantities of manure storage and loss
- Ambient temperatures

A-FERTILIZER Model

- No specific model is endorsed (e.g., DNDC, Daycent)
- Must demonstrate that model is appropriate for climate/agroecological zone in which the project is located
- Output must be the fertilizer-derived emission at a specific point in time

A-FERTILIZER Data Inputs

- Atmospheric Factors
- Daily meteorology
- Edaphic factors (e.g., clay content, soil pH)
- Cropping factors (e.g., crop type, planting and harvest dates)
- Tillage factors (e.g., date and depth of tillage)
- Fertilizer application factors (e.g., type and application rate)
- Irrigation factors (e.g., # irrigation events, date)

Thank You!

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